601 Williams Blvd., Fourth Floor
Richland, Washington
99352-3258

509/943-4640

ICF TECHNOLOGY INCORPORATED

MEMORANDUM

DATE: January 4, 1993

TO: ~~Bob~~ Benedetti

FROM: Gaynor Dawson

SUBJECT: WORK PLAN REVIEW #1 - OU4 Vadose Zone Work Plan

My staff and I have completed a review of the subject work plan as described in the December 1992 Technical Memorandum. Our general conclusion is that the plan is directed to collection of a lot of data that will be of little or no use in conduct of the RI/FS, while several important areas of investigation are not addressed. Our review was conducted in the context of our knowledge of RI/FS requirements as we addressed them under our DOD, EPA and private contracts. If there are special instructions your staff has received with respect to OU4 or unique concerns that have been raised about the solar ponds, they need to be identified.

Our review was based solely on what appears in the Technical Memorandum. We have not seen a work plan for the ground water or other related materials. In order to help you understand the basis of our comments, I have included a brief description of the requirements of a RI/FS as dictated by EPA guidelines, a synopsis of existing data on the site, and a summary of our understanding of the proposed plan. Hopefully, these sections will facilitate identification of any misunderstandings or misinterpretations if such exist. If there are no miscommunications, then we would strongly recommend revising the plan to be more responsive to needs and less expensive.

RI/FS REQUIREMENTS

As currently structured, the RI (Remedial Investigation) is intended to provide the data necessary for two key data evaluation processes: 1) the risk assessment, and 2) the feasibility study. The former supports a decision as to the need for remediation, the latter supports selection of the best remedy. As such, RI activities encompass both site characterization and treatability considerations allowing us to assess the risks to human health and the environment, identify appropriate remedial action alternatives, and gather data relevant to design/operation of remedial technologies at the site. Specific requirements are to define as appropriate:

- Site physical characteristics;
- Sources of contamination;
- Nature and extent of contamination;

- Fate and transport of contaminants; and
- Features that would affect implementation of probable remedial action alternatives.

A balance must be struck between cost and uncertainty in defining site features. Greater understanding and, hence, more certainty can be obtained at increasing levels of cost associated with higher density of samples and broader arrays of analyses. The balance is determined on the basis of adequacy of information for decision making purposes. For instance, if chemicals are known to be moving at sufficient rates to pose unacceptable risks, explicit quantification of those rates may not be needed. The extent of contamination must be known to define the volume of each environmental matrix that must be managed. However, within the defined envelop of concentrations above cleanup criteria, extensive mapping of variations is not of concern unless high concentration zones would impact the remedy selection process.

A SUMMARY OF EXISTING DATA

OU4 is an area at the Rocky Flats Plant containing a number of historic and existing ponds that have been used to evaporate low level radioactive wastes since 1953. The original three earthen ponds were in use from 1953 to 1960. These early ponds were known to leak around the base of their berms. The original ponds were first supplemented and then replaced by the five present ponds. The first of the present ponds (207A) was constructed in 1956, three more ponds were constructed in 1960 and a fifth pond was constructed in 1970.

Monitoring Wells and Borings

A total of 182 boreholes have been drilled in OU4 beginning in the 1950s. Most of the wells drilled prior to 1980 have been abandoned and replaced by approximately 80 boreholes which have been drilled since 1986. Some of these boreholes were completed as monitoring wells and some were not. Soil samples were collected from many of the borings and analyzed for chemical constituents.

Site Hydrogeology

The work plan defines two hydrostratigraphic units (HSU). The upper HSU is unconfined and consists of the Rocky Flats Alluvium, valley fill alluvium, fill materials and underlying weathered bedrock. Based on cross sections in Appendix A of the work plan, this unit is between 5 and 20 feet thick but is about 10 feet thick on average. Perched water is found locally at the base of the upper HSU and tends to flow to the North following the topography and perhaps buried channels. Groundwater from the upper HSU seeps from the hillside in several locations north of the ponds and is also collected in a series of french drains. The vadose zone investigations are explicitly designed to study only the upper HSU. The lower HSU is confined and consists of unweathered claystones, silty claystones with lenses of silty sandstones. Presumably, the lower HSU will be the subject of a saturated zone work plan if data indicate any contamination in this zone.

Site Contamination

Although the work plan does not describe the extent of contamination in much detail, some conclusions can be reached from statements in the text. Groundwater in the upper HSU is contaminated with elevated nitrate and radionuclides. The contamination has been observed in groundwater samples collected in wells and in water samples collected from seeps. The soil material within the upper HSU is also contaminated although the extent of contamination is not well characterized. Groundwater in the lower HSU is apparently not contaminated. The work plan does not mention whether chemicals other than nitrate or radionuclides have been detected in soil or water samples. Apparently, there is a possibility that solvents may be associated with aqueous wastes from drains in the 700 series buildings (Page 1-3). The work plan does not indicate whether these compounds have been detected in groundwater or soil samples.

Relevant Recharge/Vadose Zone Investigations

Several other recharge and vadose zone investigations have been completed or are underway for areas near OU4. These other extensive investigations have included several lysimeters, time domain reflectometry (TDR) probes, porous cup samplers, and neutron probes to measure vertical flux. All of these studies have taken place in areas very near OU4 (see Figure 1-3 of existing Work Plan).

Conceptual Site Model

Based on the data presented, the conceptual model for the site would seem to be relatively straightforward. Aqueous waste retained in one or more of the solar ponds migrated vertically through the base of the unlined ponds, through the contact between the base of the berms and the land surface and/or through leaks in the liners. Chemicals in the waste have migrated vertically through a thin vadose zone to a less permeable zone and have contaminated a perched water bearing unit approximately 10 feet below ground surface. Groundwater in this zone flows to the north along the slope of the perching layer and discharges to groundwater seeps directly to the north of the ponds. As a consequence, the seeps contain elevated levels of chemicals of concern. Soil in the perched zone also contains elevated levels of contaminants which have been observed under unsaturated conditions (in the dry season). Some of the perched water is being collected in an extensive network of french drains located to the north of the ponds. These drains have dewatered much of the perched zone, but not all of it (see Figure A-6 in the work plan).

By reviewing this simple conceptual site model, it is possible to identify key targets of interest for the RI to meet site characterization objectives:

- Site physical characteristics - Parameters of primary interest are the dimensions of the vadose and perched zones, the structure of the boundary surfaces, the volume of moisture in the perched zone, and the water balance. Of these characteristics, current data adequately addresses the dimensions of the vadose zone. As we understand it, a water balance has also been calculated for the

french drains and a recharge study has been conducted nearby. If that is the case, the existing data are sufficient for the vadose zone conceptual model.

- Sources of contamination - There is little doubt that the ponds are the sources of contamination. The only question would be if there are contributions from off-site sources, and that is an area of inquiry for the saturated zone investigation. Existing data on pond sludges for the Pondcrete effort and related evaluations should identify the chemicals of concern unless there is reason to believe that inputs to the ponds have changed significantly over the years. If feed materials have changed significantly, records must be reviewed to identify additional analytes. If records are not adequate, then some samples of environmental matrices (soil and perched waters) will need to be screened for the full complement of potential contaminants.

- Nature and extent of contamination - The nature of contamination is largely known by virtue of existing data on pond content and historic data on feed materials to the ponds. However, the extent of contamination is not known. Nitrate data suggest that the most mobile contaminants have already reached the perched water, the seeps, and the french drains. What must be determined is the extent to which other, less mobile contaminants have moved out from the plume. The other contaminants will have followed the same primary pathway: percolation to the perched zone, migration northward, discharge in seeps, and discharge to the french drains. The uncertainty is how far each has gotten, and the distribution between the solid and dissolved phases. In order to remove the uncertainty, sampling and analysis is required in the soil column beneath the ponds, the perched zone, and areas downgradient from the discharge points.

- Fate and transport of contaminants - It is clear that contaminants have moved from the ponds to the perched zone and subsequently, to discharge areas. The fact that contaminants have been found at each point in the pathway to the french drains clearly demonstrates that the pathway is complete. What is not known is if there are additional routes along this pathway. For instance, is all the perched water discharged to the seeps and the french drain, or does some flow in other directions or leak into the lower HSU? Little data exist on the rate at which water moves in the vadose zone, but that is of little consequence. Since it is clear that contaminants have reached the french drains and seeps, the rate is adequate to pose measurable risk.

- Features affecting the implementation of remedies - It is clear that there is perched zone contamination of water and, therefore, probably soil contamination as well. Perched zone water is likely to be remedied by dewatering the zone and treating the removed water or by in-situ bioremediation of contaminants which are susceptible to biodegradation. Soil contamination is likely to be addressed by excavation and treatment or in-situ stabilization since the vadose zone is relatively thin. Soil flushing may be the remedy of choice since lixiviants would be contained by the perching layers and french drain system. Of these candidate

technologies, the latter is the one that would require some site-specific data for evaluation in the way of permeabilities and desorption data.

The preceding comparison provides the agenda for the RI work plan. We have compared the existing plan to that agenda in order to evaluate the adequacy of the plan.

EXISTING WORK PLAN

The existing vadose zone work plan calls for:

- Installation of neutron probes and lysimeters in 16 boreholes;
- Conducting physical tests and chemical analyses on 50 soil samples;
- Conducting 32 to 48 borehole permeability tests (BAT system);
- Installation of 25 Guelph permeameters;
- Installation if double-ring infiltrometers, time domain reflectometry and neutron probes in 16 borings;
- Installing transducers in 4 to 8 existing piezometers;
- Conducting a soil gas survey with 28 stations;
- Conducting up to 24 chemical analyses on pore water samples; and
- Conducting column leachability tests.

Evaluation of the Existing Work Plan

Much of the data that would be obtained in this existing work plan would be used for characterizing the fine scale temporal and spatial details of contaminant migration in the vadose zone. For instance, saturation-hydraulic conductivity relationships would be developed which will describe the movement of wetting fronts through the vadose zone. These data could be used to predict how long it should take for water to travel from the surface to the water table under present day recharge conditions. However, historically the vertical movement of contaminants may have occurred under much different recharge conditions with respect to the earthen ponds which existed in the past. These conditions will not be further understood by the types of data that are proposed to be collected. Additionally, it would seem that this level of detail may be largely irrelevant based on the length of time that the facility has been in operation and the fact that soil and groundwater contamination are known to exist.

It is unclear that the proposed soil gas survey is justified based on existing data. No mention is made of volatiles having been detected in previous chemical analyses of soil and groundwater samples. Given the shallow groundwater conditions at the site, if VOCs have been disposed of in the area they certainly would be detected in groundwater sampling. This soil gas survey should be eliminated unless there are additional data, not presented in the work plan that suggest VOCs may be held in a zone that has not been sampled.

The proposed suite of chemical analyses for soil and groundwater samples includes volatiles, semi-volatiles, metals, pesticides, radionuclides, and nitrate. The work plan does not indicate whether all these chemicals have been detected in previous sampling events. If not,

consideration should be given to limiting the analytical suite to nitrate and radionuclides. It is not clear that chemical analyses of pore liquid samples collected in lysimeters should be conducted.

Available evidence indicates that the shallow soil is contaminated and that the perched groundwater is contaminated, it is likely that water moving through the soil will also contain elevated levels of chemicals.

The other recharge and vadose zone investigations in the immediate area of OU4 should provide sufficient data for characterizing recharge conditions in the area.

Based on these considerations, five of the nine elements of the subject work plan are unnecessary. In addition, the chemical analytes being sought can be reduced significantly. At the same time, there are omissions that should be rectified. A geophysical survey (e.g., seismic reflection or seismic refraction) should be performed to map the bedrock surface. These data would help locate preferred channels of migration as well as provide valuable data on the location and dimensions of perched zones.

It is also noteworthy that the plan calls for the contractors to maintain data in its own in-house GIS. RFEDS has a GIS capability and should be the repository for all data. EG&G can not allow contractors to control critical data. The contractor can maintain a GIS, but it should be compatible with RFEDS and backed up in RFEDS continually.

SUMMARY AND RECOMMENDATIONS

We suggest that the work plan be revised to focus on collecting data that will be useful in a feasibility study of remedial alternatives for the vadose zone soils. A quick evaluation of the available data suggests that either in-situ or ex-situ treatment of soils may be feasible. In-situ treatment technologies would include soil flushing or stabilization (vapor extraction is probably not appropriate for the chemicals of concern). Ex-situ treatment options include soil washing, stabilization and off-site disposal. The data required for each of these methods are estimates of the extent of contamination, leaching characteristics of contaminants and physical characteristics of the soil such as grain size distributions, porosity, and hydraulic conductivity.

Based on the fact that the depth to perched groundwater is approximately 10 feet and that nitrate and radionuclides have reached groundwater over 30 years ago, a detailed understanding of contaminant migration through the vadose zone seems to be generally irrelevant for the feasibility study. Therefore, much of the proposed work plan is directed towards collection of data that may not be useful in the future. The following work is recommended to be part of a vadose zone study.

Water Balance

The work plan references an existing water balance study (Page 2-20), which may have enough detail to characterize infiltration rates at OU4. These data combined with the extraction rate from the French Drain system should be evaluated on an annual time scale. It is also worthwhile to

collect continuous water level data from piezometers as proposed to characterize recharge conditions. These data should be supplemented with an on-site precipitation gage. Comparison of continuous hydrographs to precipitation records will provide a great deal of data on recharge rates, travel times and the water balance.

Extent of Contamination

Existing soil chemistry data should be supplemented as necessary to adequately characterize the extent of contamination. The existing work plan may do this, but we do not know since we have not seen the existing data

Physical Characteristics

The laboratory tests proposed in the work plan should adequately address the gaps in physical characteristics data.

Leachability

The proposed column leachability studies would provide useful data although existing sources and literature studies should be evaluated to determine the applicability of readily available data for the feasibility study.

Surface Mapping

A geophysical survey should be added to the work plan.